m/027/030

State of Utah
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY

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DIVISION OF
OIL GAS & MINING

September 28, 1992

Mr. Robert A. Prescott
Topaz Beryllium Venture
P.O. Box 280
Delta, UT 84624

RE: Revised Ground Water Discharge Permit Application

Dear Mr. Prescott:

We have reviewed your revised ground water discharge permit application received on July 23, 1992. Several issues, including some mentioned in our earlier correspondence, need to be addressed.

General Comments:

We plan to issue a combined Construction and Ground Water Permit for the facility, when the requirements for the permits are fulfilled. Subsequent disposal of sanitary wastewater will be approved by the Central Utah District Health Dept if the sanitary wastewater flow is less than 5,000 gallons per day (gpd). Otherwise, plans for the disposal system must be submitted to the Division for review and approval.

General Comments on the Wastewater Impoundment and Spent Ore Cell :

Your report contained an analysis of a sample of raffinate from metallurgical testing. This sample contained several constituents which greatly exceed the Utah Ground Water Quality Standards as follows:

A.	*TDS	E.	*Hg	I.	*Cr	M.	*As
B.	**$SO4^{-4}$	F.	*Pb	J.	*Cd		
C.	*Zn	G.	*F	K.	**Be		
D.	*Se	H.	Ag	L.	*Ba		

*Also exceed MCL's ** Exceed draft MCL's

In most settings, such wastewater would need to be contained in an impoundment which incorporated at least one flexible membrane liner and a leak detection system. We urge Topaz Beryllium to carefully evaluate the feasibility of a more protective liner design than the one proposed. This may allow for less stringent requirements for compliance monitoring, contingency and closure plans, and may lessen the possibility of ground water contamination and future liability for environmental damage for the company.

Topaz Beryllium must demonstrate that ground water protection levels will not be exceeded before the permit is issued, by compliance monitoring during the term of the permit and also post-closure as necessary. An earthen liner will require a stricter compliance monitoring plan than a synthetic liner system. It is also likely that leachate from the spent ore will have similar chemical characteristics, so the disposal cell will have similar requirements, although design of this cell will be different because it will be used for storage of a solid material. The use of earthen liners may be acceptable if you are able to demonstrate that contaminants will be attenuated and maintained on your property. The existence of an upward hydraulic gradient between deep confined aquifers and the shallow water table aquifer would be of great importance in evaluating contaminant transport at the site, and this should be demonstrated conclusively. Properties of engineered portions of the containment system and subsurface native soils must also be known accurately enough to allow meaningful contaminant transport modeling. Accordingly, bottom liners possibly could be constructed by scarifying, mixing and recompacting the native soils as necessary to 95% density with moisture content about 2% greater than optimum. Hydraulic conductivity of the entire liner must be established by an appropriate QA/QC program. An acceptable method is attached for reference.

In order to use an earthen liner design, Topaz Beryllium must demonstrate through contaminant transport analysis that ground water protection levels will not be exceeded during the facility's operation and after closure. Such analysis will require thorough knowledge of the local ground water flow system, wastewater and leachate chemistry, and geochemical properties of the aquifer and vadose zone materials. This analysis must include both the shallow water table aquifer and upper confined aquifer, unless investigation indicates that the confined aquifer will not be affected by the facility.

As stated in our letter of April 22, 1992, specific contingency and closure plans would be required if Topaz Beryllium chose an earthen liner design. The current submittal does not address these requirements for the wastewater lagoon and the spent ore depository. These plans should contain statements which commit the company to take actions which would prevent ground water contamination after protection levels are exceeded in a downgradient monitor well during operation of the facility, and also after closure of the impoundment and depository.

Preliminary project drawings and specifications may be submitted now, incorporating the comments in this letter. This would help keep the project moving toward completion.

Wastewater Lagoon:

Because the proposed lagoon design has the potential to affect both the shallow water table aquifer and the upper confined aquifer, both of these hydrogeologic units must be monitored, unless it can be demonstrated that the confined aquifer would not be affected by the facility. A meaningful compliance monitoring well network can be designed only when the site's hydrogeologic characteristics are well known. It is particularly important to have detailed knowledge of the horizontal and vertical hydraulic gradients and the degree of interconnection between the two aquifers. Background ground water quality and protection levels may need to be established for both aquifers. Background water quality for the water table aquifer should be based on nearby upgradient or lateral gradient ground water in this same hydrogeologic unit unaffected by discharge from the flowing well on the site. All monitor wells must be screened exclusively within either the water table aquifer or upper confined aquifer, but not across both.

Spacing between downgradient wells in the water table aquifer (placed as close to the lagoon's perimeter as practical) must take into account the potential dispersion which would occur in the underlying aquifer materials. The monitor well network must be able to detect a contaminant plume from a point source leak in the center of the impoundment as rapidly as possible. Because the upper confined aquifer is less likely to be affected by discharges, fewer wells may be needed as long as the hydraulic gradient remains upward and protection levels are not exceeded in the water table aquifer wells. If the vertical hydraulic gradient is downward, wells in the confined aquifer should be capable of detecting plumes which may preferentially flow in the more permeable materials of the confined aquifer. If the hydraulic gradient is downward, such plumes may be detected in the confined aquifer before they reach the water table monitor wells.

Spent Ore Disposal Cell

Topaz Beryllium must demonstrate by contaminant transport modeling that leachate from the disposal cell will not cause an exceedance of ground water protection levels at the compliance monitoring wells. Assuming that materials placed into the cell would not be free-draining, such leachate would be produced by infiltration of rain and snowmelt into the spent ore. Accordingly, a prediction should be made of the chemistry of the leachate, and a bottom liner and final cover should be designed which would minimize infiltration, leachate formation and discharge to levels which would be acceptable for the site characteristics as determined by contaminant transport predictions. Continuous construction is proposed for the spent ore disposal cell. The cell should be large enough to operate for a minimum number of years before expansion is necessary. Sizing for 5 to 10 years is recommended. The operating plan for the cell should also minimize the time the spent ore is exposed to precipitation before installation of the final cover.

The latest report indicates that the tailings placed into the repository would contain about 30% water, although they would not be free-draining at first. As the ore is stacked to about 20 feet depth, the report indicates that the loading would compress the lower levels of ore materials so that their permeability would be around 2×10^{-7} cm/sec. It is likely that water would be squeezed out of the material and cause a discharge to the underlying soils or ground water. Design of the disposal cell should take this discharge into account.

Ore Heap and Ponds:

1. An analysis of the heap structural stability should be submitted with the preliminary design.

2. The asphalt cover and the synthetic flexible membrane liners should be analyzed for compatibility and corrosion resistance with the leachates. The manufacturer's design literature on this should be submitted with the preliminary plans and specifications.

3. Heaps will need to have a dual perimeter liner installed. An example drawing of this is included.

4. If any leachate leakage is detected, leaching would discontinue and repairs commence. This does not include pad perimeter leaks. This leakage must be corrected within a week. Pad leaching would not need to be stopped unless the perimeter leak detection system leakage exceeded 0.25 gpd.

5. For each pond, maximum allowable leakage rate into the individual leak detection system is 200 gallons per acre per day. The effected ponds must be closed if leakage exceeds this amount.

Please contact Messrs. Novak or Rupp if you have any questions or would like to meet with us on these issues.

Sincerely,

Don A. Ostler

Don A. Ostler, P.E.
Director

Enclosure

DAO:mn/rvg

cc: JBR Consultants
Bruce Hall, Central Utah District Health Dept.
Wayne Hedberg, Div. of Oil, Gas, Mining
Roger Foisy, District Engineer
Bureau of Land Management

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FILE:TOPAZ BE IND. WW

LAGOON LINERS

Design, Testing and Construction

Quality Control and Assurance Method

This method when used to design liners, may not always be effective. It is possible to gain added reliability, and a deeper understanding of the soils by implementing a more extensive testing program to correlate field permeability to lab permeability, density, plasticity index, gradation, and other parameters. The procedure listed below is considered an acceptable method to satisfy the requirements of R317-3, Chapter 10, seepage requirements. Other correlation methods may be proposed in order to satisfy the requirements.

I. DESIGN:

Candidate Liner Identification and Laboratory Testing: It is necessary to identify and laboratory test material to qualify it as a candidate liner for field testing. The material may be all insitu, an imported stockpiled soil to be used as a liner, or a mixture of soils. Initial testing on a bench scale may be prudent, to experiment with mix design or to qualify a potential source for further laboratory testing.

The proposed liner or mix substrate source should be investigated by sampling on a grid, with at least one sample for each 1500 cubic yards of liner material, corresponding to a 200' X 200' X 1' volume. Tests for plasticity index (PI) and soil classification should be recorded for each sample. If a mix design is proposed, the PI and soil classification for it should also be done.

Thence, it may be desirable to segregate and eliminate some material types to obtain one, or in some cases, more than one soil classification type. After adjusting the material, the proposed design(s) should be tested at design head, using the constant head permeability test (CHP), described in ASTM D 2434. The maximum dry density (MDD) and moisture content (MC), of such liner materials before they are saturated for CHP testing, should be recorded. The method of determining the MDD, i.e. ASTM D 698 (standard density) or ASTM D 1557 (modified density) should be indicated.

To qualify for field testing the laboratory CHP permeability of each candidate design liner must be the lesser of $K=1 \times 10^{-6}$ centimeters/second or in the case of lagoons deeper than six feet, the permeability, K, required to attain Q less than 6500 gallons/acre-day. Where Q=KiA in the Darcy equation.

Selection: Based on the findings above, a candidate design standard should be proposed for each soil type. The design standard should be selected with care, to ensure proper permeability, and ease of construction replication. The candidate design will be used to construct field tests. At least three field test patches should be constructed, or one for each material type, whichever is more.

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II. FIELD TEST THE DESIGN:

After successful field testing of the candidate liner material(s), a liner may be specified for construction of the lagoon liner.

Test Patches: Field test patches should be constructed, using the specified design liner(s) and the design construction method. The patches should then be tested by ASTM D 5093, Sealed Double-Ring Infiltrometer Test (SDRI), or a sealed single-ring infiltrometer (SSI). The SDRI is the preferred test, however it is expensive. The SSI test must use a minimum 63-inch (1.6 m) diameter ring, and the shape factor may not be used to correct the permeability to meet the requirements. Also, the SSI must be sealed to exclude both precipitation and evaporation. Record the CHP, dry density, moisture content, plasticity index, sieve analysis, and USCS name for each patch, using an extraction from each constructed patch.

If the field test patch for the design standard fails to demonstrate minimum acceptable permeability, then the liner should be redesigned and retested. The test patch permeability for the design standard must be the lesser of $K=1 \times 10^{-6}$ cm/sec or in the case of lagoons deeper than six feet, the permeability, K, required to attain Q less than 6500 gallons/acre-day. Where Q=KiA in the Darcy equation. The complete results and interpretation of proper field patch tests for the liner(s) should be submitted.

III. CONSTRUCTION QUALITY ASSURANCE:

Compaction and Moisture Content: Compaction and moisture content specified for the liner must be consistent with the design. Moisture content should be specified to be at, or above the optimum moisture percentage. The liner must pass all density and moisture tests run on a grid system of maximum 100 X 100-foot grid lines, for each lift.

Liner Characteristics: Sieve analysis and the Atterberg limits for the installed liner must be tested on a minimum of 200 X 200 foot grids per lift. If a liner material coarser than the design gradation or with a smaller plasticity index is discovered, the material should be removed. If it is desired to retain the material, it must be tested by CHP, and be at least equal to or less than the permeability of the design standard. If the material will not meet the minimum CHP requirements, then it must be successfully field patch tested in order to be retained.

Reference:

State-of-the-Art Hydraulic Conductivity Testing of Compacted Soils, by Joseph O. Sai, et.al., June 1991, EPA/600/2-91/022.

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LAGOON LINERS
Design, Testing and Construction
Quality Control and Assurance

SUMMARY OF STEPS

This information is furnished as a summary of an approved method. This summary should not be used without reference to the written method.

Design:

1. Select candidate liner material or mix substrate.

2. Sample material at one sample per each 1500 cubic yards.

3. Determine the plasticity index (PI) and Unified Soil Classification System (USCS) name for each sample.

4. Segregate and eliminate inferior materials from consideration.

5. Laboratory test the proposed liner material constant head permeability (CHP) at design head, using ASTM D 2434. The maximum dry density standard and the moisture content for the tested material should be indicated.

6. To qualify for further testing, the proposed liner CHP must correspond to a discharge less than 6500 gallons per acre-day, where Q= K i A in the Darcy equation.

Field Test the Design:

1. Construct and test field test patches. The candidate design will be used to construct field tests. At least three field test patches should be constructed, or one for each material type, whichever is more.

2. Test each the constructed patches using ASTM D 5093, Sealed Double-Ring Infiltrometer Test (SDRI), or a sealed single-ring infiltrometer (SSI). Record the CHP, dry density, moisture content, plasticity index, sieve analysis, and USCS name for each patch, using an extraction from each constructed patch.

3. Results of field tests for a successful material must conclude the design corresponds to a discharge less than 6500 gallons per acre-day, where Q= K i A in the Darcy equation.

4. The field patch permeability, CHP, Unified Soil Classification System name, PI, sieve analysis graph, maximum dry density and moisture content value should be obtained and recorded for the final design liner(s). This value should be specified as the construction standard.

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Construction:

1. Liner must pass all density and moisture content tests on a 100' X 100' grid for each lift.

2. Sieve analysis and PI will be tested on a 200' X 200' grid maximum for each lift. If a liner material coarser than the design gradation or with a smaller plasticity index is discovered, the material should be removed. If it is desired to retain the material, it must be tested by CHP, and be at least equal to or less than the permeability of the design standard. If the material will not meet the minimum CHP requirements, then it must be successfully field patch tested in order to be retained.

N: QASUMM.492
Utah Division of Water Quality April 1992

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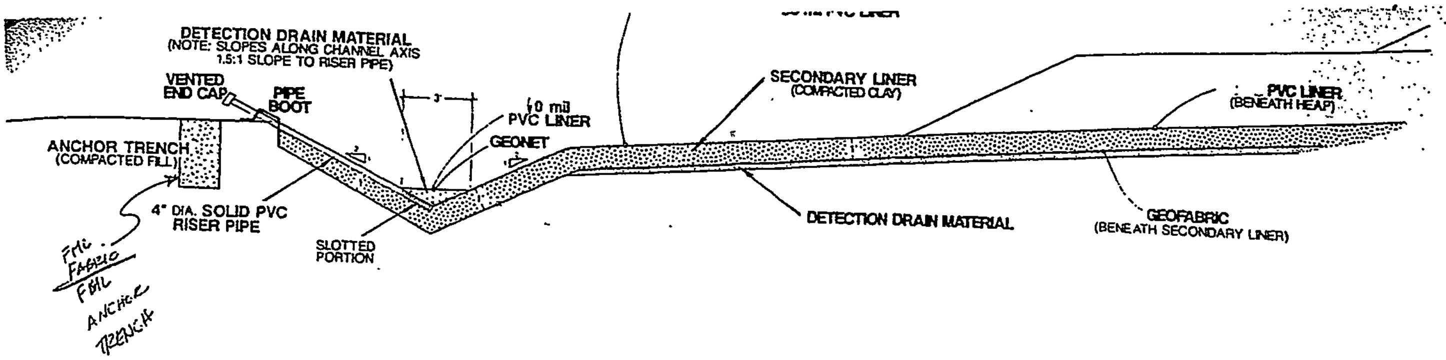
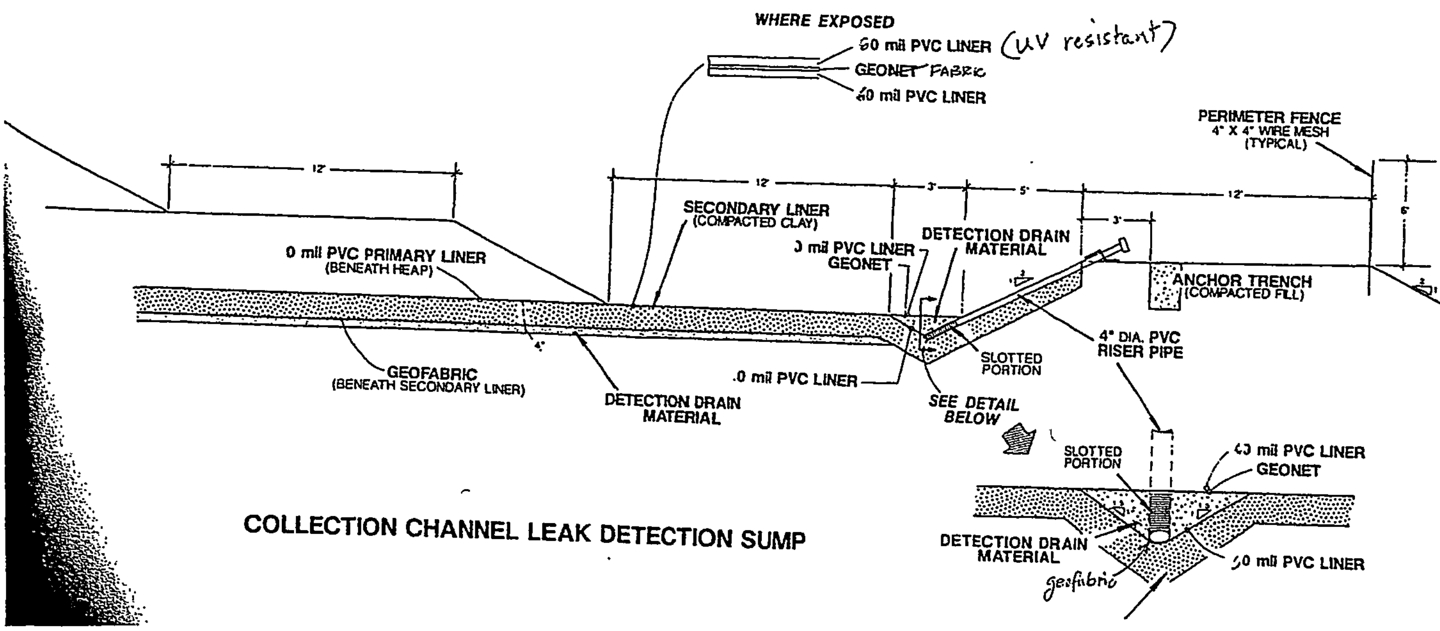


COLLECTION DITCH LEAK DETECTION SUMP



COLLECTION CHANNEL LEAK DETECTION SUMP

DESIGN SCHEMATIC

N.T.S.

IN SOLUTION CONVEYING BOUNDARIES:
SUMPS AT 150' O.C. ±.

Enclosure #2 Sheet 1/1